

HIGH RESOLUTION LINE PROFILE STUDIES FROM ELECTRON IMPACT EXCITATION OF H_2

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The emission spectrum of H_2 produced by electron impact excitation has been studied in the FUV¹. High resolution spectra of the Lyman and Werner band systems and the line profile of H Lyman- α have been obtained with a new high resolution ($\lambda/\Delta\lambda = 50000$) UV spectrometer in tandem with electron impact collision chamber. Analysis of high resolution Jupiter spectra from the Goddard High Resolution Spectrometer (GHRS) require more accurate laboratory data. The most prominent emission line in the uv airglow of the outer planets is H ϵ . High resolution measurements of H $L\alpha$ emission from Jupiter's aurora by GHRS reveal a 2 Å wide Doppler broadened wing profile. Electron impact dissociation of H_2 is believed to be one of the major mechanisms leading to the observed wide profile. The kinetic energy distribution of H(2p) atoms resulting from electron impact dissociation of H_2 has been measured². The distribution is based on the first measurement of the H Lyman- α (H $L\alpha$) emission line Doppler profile. Analysis of the deconvolved line profile reveals the existence of a narrow line peak (39 mÅ FWHM) and a broad pedestal base (240 mÅ FWHM). Three distinct dissociation mechanisms account for this Doppler structure. Slow H(2p) atoms with peak energy near 80 meV and full-width-half-maximum (FWHM) of 260 meV produce the peak profile, which is nearly independent of impact energy.

Slow H(2p) atoms arise from direct dissociation and predissociation of singly excited states which have a dissociation limit of 14.68 eV. The wings of H $L\alpha$ arise from dissociative excitation of a series of doubly excited Q_1 and Q_2 states, which define the core orbitals. The energy distribution of the fast atoms shows a peak at 4 eV with a FWHM of 2 eV. A third type of dissociation process is found from the observation of a threshold for cascade from the Balmer- α line. The threshold for this process is measured to be 16.67 eV and arises from dissociative excitation of H_2 from Rydberg states. Cascade contributes to the population of both the slow and fast H(2p) atom kinetic energy distributions. The identification of important states contributing to the dissociation process is clearly evident from measurements of the optical excitation function, including the measurement of the lowest possible threshold for a doubly excited state at 23 eV by the $Q_1(^1\Sigma_g^+(1))$ state.

Reference

1. Ajello, J. M., S. M. Ahmed, I. Kanik, and R. Multari, *Kinetic energy distribution of H(2p) from dissociative excitation of H_2* , **Phys. Rev. Lett.**, in press, 1995.
2. X. Liu, S. M. Ahmed, J. M. Ajello, G. K. James, R. Multari, H. Hu and D. E. Shemansky, *High Resolution Electron Impact Spectrum of Molecular Hydrogen* **Ap. J. Supp.**, In Press (1995).